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(71) Applicant(s)  
EEV Limited

(Incorporated in the United Kingdom)

106 Waterhouse Lane, CHELMSFORD, Essex,  
CM1 2QU, United Kingdom

(72) Inventor(s)  
Alan Griggs  
Barry James Arnold

(74) Agent and/or Address for Service  
G Cockayne  
GEC Patent Department, Waterhouse Lane,  
CHELMSFORD, Essex, CM1 2QX, United Kingdom

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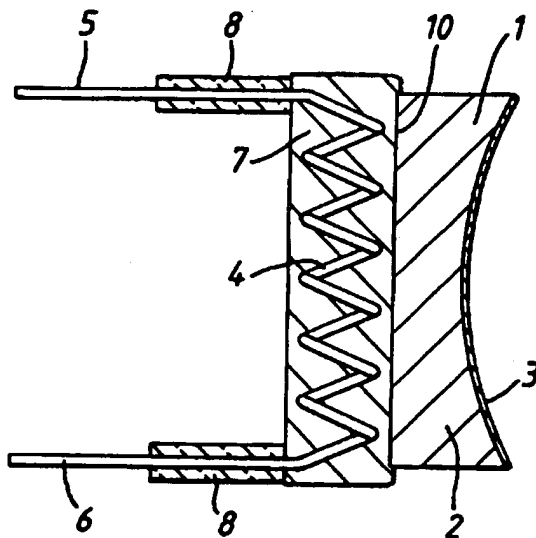
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None

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(54) Cathode arrangements utilizing diamond as an insulator

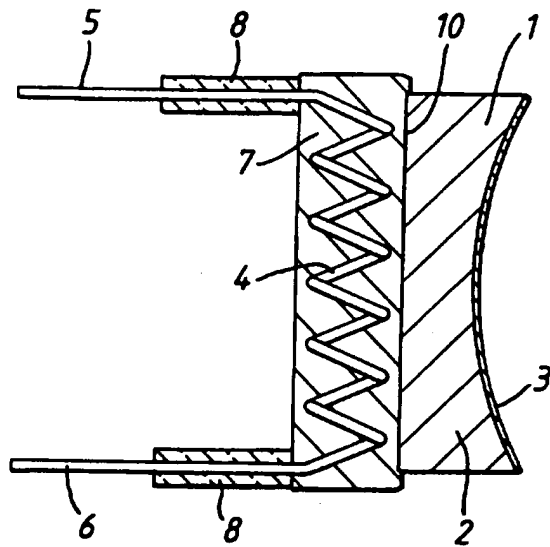
(57) A cathode arrangement includes a heater filament 4 coated with diamond 7 which has a high thermal conductivity and is electrically insulating. The heater filament is arranged adjacent a cathode member 1 and is arranged to heat thermionic material 3 on the front surface of the cathode 1 to its operating temperature. The arrangement is suitable for use in travelling wave tubes, cathode ray tubes and other devices incorporating electron guns.



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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### Cathode Arrangements

This invention relates to cathode arrangements and more particularly to thermionic cathodes in which heat is supplied to the cathode by passing an electrical current through a heater filament.

Thermionic cathodes are used in many types of device, for example travelling wave tubes, cathode ray tubes and magnetrons. It is often desirable that such cathodes reach their operating temperature, at which electrons are emitted, in a relatively short time and that they are of relatively high efficiency.

The present invention arose from the consideration of improvements in cathode arrangements.

According to the invention, there is provided a cathode arrangement comprising an electrically conductive heater filament coated with diamond and arranged adjacent a cathode member for supplying heat thereto when electrical current is transmitted via the filament.

Diamond is a dielectric material and also has a very high thermal conductivity which is approximately six times greater than the thermal conductivity of copper, for example. Use of diamond permits the heater filament to be electrically insulated whilst providing a particularly good thermal path to the cathode member. The low thermal capacity leads to short warm-up times and also provides a relatively high efficiency arrangement compared to

conventional heater components.

The diamond may be applied to the heater filament using chemical vapour deposition techniques in a plasma in which a layer of artificial diamond is produced on a substrate. The invention is particularly applicable to heater filaments configured as a coil or other convoluted configuration in which parts of the filament are located relatively close together, as the diamond prevents arcing or shorting between adjacent parts of the filament, giving good reliability.

In one advantageous embodiment of the invention, the heater filament is embedded in diamond. Thus, where the heater filament is configured as a coil, the spaces between different turns of the coil are substantially completely occupied by diamond. This gives a structure in which all parts of the filament contribute, via conduction through diamond over a large surface area, to the thermal heating effect on the cathode. It also results in a solid structure having a large face which may be fixed readily to the cathode member. In a preferred embodiment, the diamond is metallised and brazed to the cathode member.

In one embodiment of the invention, a coating of thermally insulating material is deposited on the ends of the heater filament, thereby reducing thermal losses in a direction away from the cathode member.

One way in which the invention may be performed is now described by way of example with reference to the accompanying drawing in which the sole figure is a schematic

part-sectional view of a cathode arrangement in accordance with the invention.

In a cathode arrangement for use in a travelling wave tube, a cathode member 1 includes a substrate 2 and layer 3 of thermionic electron emissive material located on the concave front face of the cathode member 1. The cathode 1 is heated by means of a heater coil 4 which is arranged as a flat double spiral having ends 5 and 6. The heater coil is of tungsten, tantalum or molybdenum or an alloy of these refractory metals and is embedded in a block of diamond 7 laid down as a coating on the coil 4 by chemical vapour deposition. The ends 5 and 6 of the heater filament are coated with ceramic material 8 which is electrically insulating and has low thermal conductivity. The front surface 10 of the diamond block 8 is polished and metallised and fixed to the rear surface of the cathode member 1 by brazing to give a good thermal path from the heater coil 4 to the emissive material 3.

In this embodiment of the invention, a relatively low potential difference of between 5 to 6 volts is applied between the ends 5 and 6 of the heater coil 4.

The invention may be used in other types of device, for example, cathode ray tubes and magnetrons.

**CLAIMS**

1. A cathode arrangement comprising an electrically conductive heater filament coated with diamond and arranged adjacent a cathode member for supplying heat thereto when electrical current is transmitted via the filament.
2. An arrangement as claimed in claim 1 wherein the heater filament is of a convoluted configuration.
3. An arrangement as claimed in claim 1 or 2 wherein the heater filament is embedded in diamond.
4. An arrangement as claimed in claim 1, 2 or 3 wherein a surface of the diamond is metallised and fixed to the rear surface of the cathode member.
5. An arrangement as claimed in claim 4 wherein the diamond is brazed to the rear surface.
6. An arrangement as claimed in any preceding claim and including thermally insulating material coating ends of the heater filament.
7. A cathode arrangement substantially illustrated in and described with reference to the accompanying drawing.

**Patents Act 1977**  
**Examiner's report to the Comptroller under Section 17**  
**(The Search report)**

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**Relevant Technical Fields**

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(ii) Int Cl (Ed.6) H01J

Search Examiner  
 MATTHEW GILLARD

Date of completion of Search  
 7 DECEMBER 1995

**Databases (see below)**

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Documents considered relevant following a search in respect of Claims :-  
 ALL

**Categories of documents**

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| <p><b>X:</b> Document indicating lack of novelty or of inventive step.</p> <p><b>Y:</b> Document indicating lack of inventive step if combined with one or more other documents of the same category.</p> <p><b>A:</b> Document indicating technological background and/or state of the art.</p> | <p><b>P:</b> Document published on or after the declared priority date but before the filing date of the present application.</p> <p><b>E:</b> Patent document published on or after, but with priority date earlier than, the filing date of the present application.</p> <p><b>&amp;:</b> Member of the same patent family; corresponding document.</p> |
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Category	Identity of document and relevant passages	Relevant to claim(s)
	NONE	

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